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# SEED MORPHOLOGICAL STUDIES IN THE INDIAN ISUBGOL OF COMMERCE

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## ABSTRACT

*Plantago ovata* L. (Plantaginaceae) is known as 'Isubgol' and the seeds are used in medicine. Seeds of *P. amplexicaule*, *P. lanceolata*, *P. afra* and *P. asiatica* are also used as substitutes or mixed with the seeds of *P. ovata*. Seeds of *Salvia aegyptiaca* (Labiatae) are also found to be mixed with isubgol. To identify and distinguish them from each other, the seeds of all Indian species of *Plantago* along with those of *Salvia aegyptiaca* have been studied. Correct names, local names, description, distribution in India and their uses along with a key to the species are provided in this work.

## INTRODUCTION

'Isubgol', being largely used in different systems of medicines, is an important article of commerce. Seeds of *Plantago ovata* is the true isubgol but seeds of *P. lanceolata*, *P. amplexicaule*, *P. asiatica* and *P. afra* are also reported to have been used as substitutes or in mixture with the seeds of *P. ovata* which are used in some human ailments. The active medicinal properties are in the mucilagenous testa of the seeds.

For its mucilagenous testa, the seeds of *Salvia aegyptiaca* of the family Labiatae are also used as substitute of isubgol or mixed with it and they are found to have more or less the similar phytochemical properties like those of *P. ovata*.

To facilitate identification of the seeds and distinguish them from one another, all the Indian species of *Plantago* have been studied in this work along with the seeds of *Salvia aegyptiaca*. In spite of their similarity in the small size and mucilagenous testa, the seeds of *S. aegyptiaca* can readily be distinguished from those of the species of *Plantago*. The distinguishing characters are as follows :

| | | |
|---|---|---|
| 1. | Seeds peltate, flat; micropyle away from the hilum .. | *Plantago* sp. |
| 1'. | Seeds erect, triquetrus; micropyle near the hilum .. | *Salvia aegyptiaca* |

There is very little difference in seeds among some species of *Plantago* and is rather difficult to key them out. Seeds of *P. asiatica* are very much like those of *P. depressa* in their morphological character, the only major difference being in the number of seeds in a cell of the capsule.

## MATERIAL AND METHOD

Capsules were collected from the authentic herbarium sheets of the Central National Herbarium and Industrial Section, Indian Museum of the Botanical Survey of India. They were soaked in water and seeds were taken out of the cells. Number of seeds per cell in each species were noted. The seeds were examined under the microscope and their shape, size, colour, texture, surface and presence or absence of mucilage were noted for every species. Nature of endosperm, position of embryo in transverse section were seen. Size of embryo, position

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of radicle and relative length of the radicle and cotyledons were studied. Figures were drawn from microscopic preparations. Distribution of each species were noted from the herbarium and literature.

## PLANTAGO L.

Capsules membranous, circumscissile, 2-celled, cells 1-8-seeded. Seeds usually peltate, developed from anatropous ovules, margins usually raised and recurved, thickened towards the middle forming a median ridge. Seed coat consists usually of mucilagenous testa and hard tegmen. Endosperm fleshy. Embryos cylindric, radicle inferior ; cotyledons usually compressed, vertical or parallel to plain.

A cosmopolitan genus with about 270 species ; about 9 species in India of which 5 are used in medicine.

### KEY TO THE SPECIES
(Based on seed characters)

- 1. (Cells of capsules more than 1-seeded) ; seeds variable in shape ; margins neither raised nor recurved ; cotyledons parallel to plain :
  - 2. Testa rugulose ; margins thin :
    - 3. (Cells 4-8-seeded) ; seeds golden brown .. 1. *P. asiatica*
    - 3'. (Cells 2-3-seeded) ; seeds blackish-brown .. 2. *P. depressa*
  - 2'. Testa glabrous; margins thickened 3. *P. himalaica*
- 1'. (Cells of the capsules usually 1-seeded) ; seeds regular in shape ; margins raised and recurved ; cotyledons vertical to plain :
  - 4. Seeds more than 4 mm long : margins recurved usually on one side .. 4. *P. amplexicaule*
  - 4'. Seeds less than 4 mm long ; margins recurved on both sides :
    - 5. Seeds boat-shaped .. 5. *P. ciliata*
    - 5'. Seeds ovate, ovate-oblong or linear-oblong :
      - 6. Seeds linear-oblong :
        - 7. Seeds less than 3 mm long ; testa mucilagenous .. 6. *P. afra*
        - 7'. Seeds more than 3 mm long ; testa without mucilage .. 7. *P. exigua*
      - 6'. Seeds ovate or ovate-oblong :
        - 8. Seeds ovate-oblong, 2 mm long, black, thinly mcilagenous .. 8. *P. lanceolata*
        - 8'. Seeds ovate, 3 mm long, brown, highly mucilagenous .. 9. *P. ovata*

**1. Plantago asiatica** L. Sp. Pl. 163. 1753 ; Hook. f. Fl. Brit. India 4 : 705. 1885 (as syn. of *P. major*).

*Local names* : Gul, Isafgul (Kashmir) ; Ghuzbi, Gul, Isafgol, Karel (Punjab) ; Luhuriya (Kumaon) ; Sirapotta gida (Kanada).

Cells 4-8-seeded. Seeds 1.5-2.0 × 1.0 mm, golden brown, variable in shape, angular, rectangular, rhomboid, tongue-shaped, plano-concave or plano-convex, margins thin, thickened towards the middle. Hilum on the thickened region ; micropyle at the margin of the broader end. Seed coat consists of rugulose mucilagenous testa and hard tegmen. Endosperm fleshy. Embryo 1.0-1.5 mm long, within the endosperm below the thickened region ; radicle cylindric, inferior, shorter than the cotyledons ; cotyledons thick, flat, parallel to the plain. [Figs. 1(A-C)].

*Distribution* : Throughout India.

*Uses* : Seeds used as tonic, stimulant and a remedy for dysentery. Also used as substitute of *P. ovata*.

**2. P. depressa** Willd. Enum. Pl. Hort. Berol. Suppl. 8. 1813. *P. tibetica* Hook. f. Fl. Brit. India 4 : 706. 1885.

Cells 2-3-seeded. Seeds ± 2.0 × 1.0 mm, blackish-brown, variable in shape, oblong, ovate-oblong, tongue-shaped, plano-convex ; margins thin, thickened about the middle. Hilum on the thickened centre ; micropyle at the margin of the broader end. Seed coat consists of rugulose thin mucilagenous testa and hard tegmen. Endosperm fleshy. Embryo small, little more than 1.0 mm long with short inferior radicle and cotyledons parallel to plain. [Figs. 2(A-C)].

*Distribution* : Western Himalaya, Himachal Pradesh, Jammu & Kashmir, Sikkim and Uttar Pradesh.

**3. P. himalaica** Pilger in Engl. Pflanzenr. IV 269 (Heft 102) 1 : 62. 1937. *P. brachy-*

*phylla* Edgew. in Decne in DC. Prodr. 13(1) : 696. 1852, non Roem et Schult. 1819 ; Hook. f. Fl. Brit. India 4 : 708. 1885.

Cells 2-3-seeded. Seeds ± 1.5 × 1.0 mm, black, variable in shape, ovate-oblong, ovate-elliptic or rhomboid, plano-convex, margins thickened, not raised, median ridge present. Hilum on the centre of the median ridge ; micropyle at one end of the margin. Seed coat consists of thinly mucilagenous testa and hard tegmen. Endosperm fleshy. Embryo *ca* 1.0 mm long within the endosperm ; radicle inferior, short ; cotyledons parallel to plain. [Figs. 3(A-C)]

*Distribution* : On the Himalayas, Punjab, Uttar Pradesh and Jammu & Kashmir.

4. **Plantago amplexicaule** Cav. Icon. Descr. 2 : 22, t. 125. 1793 ; Hook. f. Fl. Brit. India 4 : 706. 1885.

*Local names* : Isafghol (Punjab) ; Ispaghul (Urdu).

Cells usually 1-seeded. Seeds 4.0-5.0 × 2.0-3.0 mm, brownish black, broadly oblong, plano-convex, margins raised and recurved on one side, thickened along the middle forming the median ridge with a depression along the top of the ridge. Hilum at the centre of the ridge, micropyle at one end of the ridge at the margin. Seed coat consists of thin mucilagenous testa and hard tegmen. Endosperm fleshy. Embryo 3.5-4.3 mm long within the endosperm ; radicle inferior ; cotyledons thick, compressed, vertical to the plain. [Figs. 4(A-C)]

*Distribution* : Punjab plains, Maharastra and Rajasthan.

*Uses* : This is the source of 'brown isubgol' of commerce. The seeds are said to be astringent and used in intermitent fever, pulmonary affections and as an application to eye in ophthalmia.

5. **P. ciliata** Desf. Fl. Atlant. 1 : 137, t. 39, f. 3, 1769 ; Hook. f. Fl. Brit. India 4 : 707. 1885.

Cells 1-seeded. Seeds ± 2.5 × 1.5 mm, blackish-brown, boat-shaped, plano-convex with raised and recurved margins, thickened along the middle forming the median ridge. Hilum on the centre of the median ridge, micropyle at one end of the ridge at the margin. Seed coat consists of thin mucilagenous testa and hard tegmen. Endosperm fleshy. Embryo *ca* 2.0 mm long with inferior radicle and compressed thick cotyledons ; cotyledons longer than radicle, vertical to plain. [Figs. 5(A-C)]

*Distribution* : Pünjab and Maharastra.

6. **P. afra** L. Sp. Pl. ed. 2, 188. 1762. *P. psyllium* L. sensu Sp. Pl. ed. 2, 167. 1762 non Sp. Pl. 115. 1753 ; Hook. f. Fl. Brit. India 4 : 707. 1885.

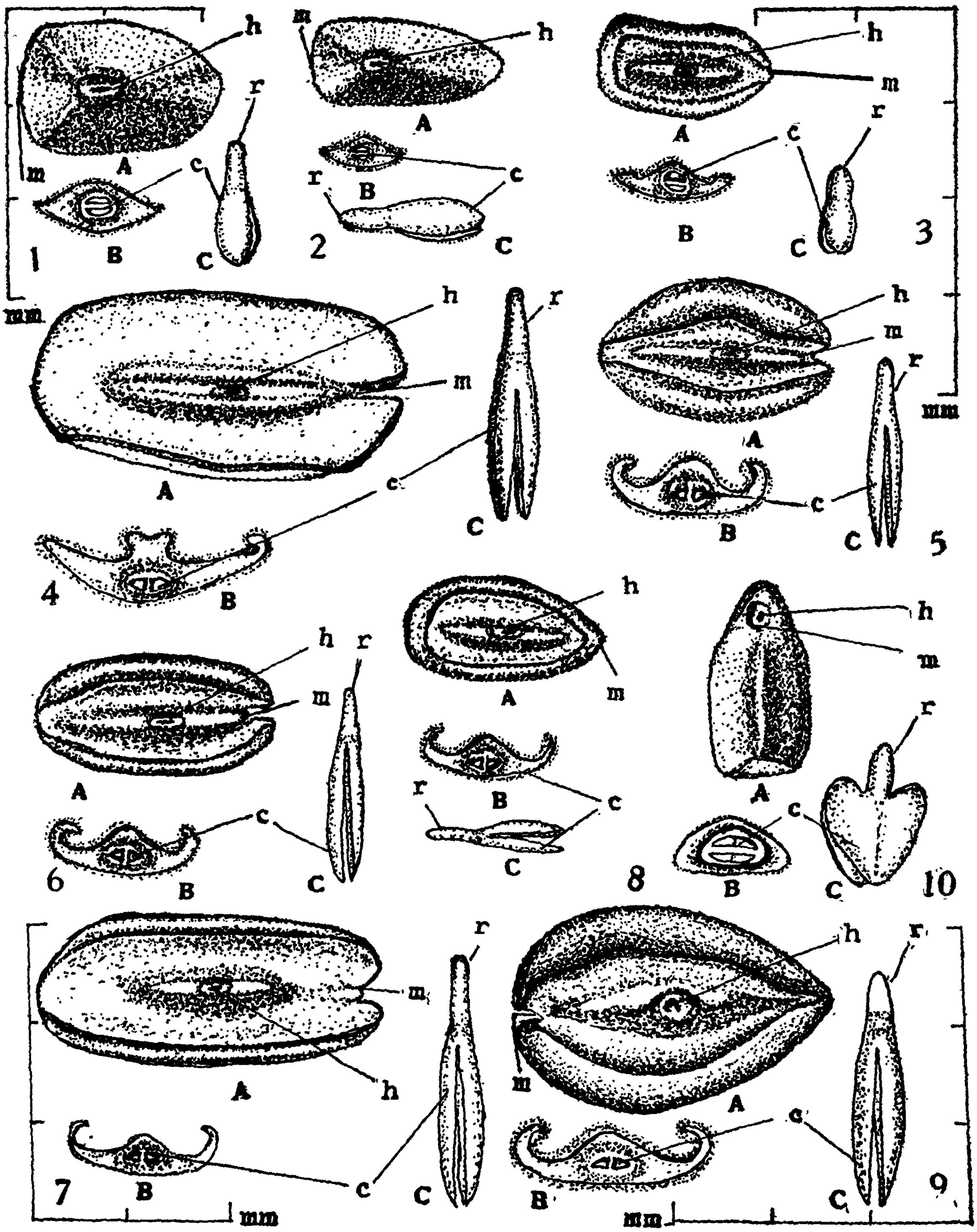
*Local name* : Kala isabgol (Hindi).

Cells 1-seeded. Seeds ± 2.5 × 1.0 mm, yellowish-brown, linear-oblong, margins raised and recurved, raised along the middle forming the median ridge. Hilum at the centre on the ridge and micropyle away from the hilum at the end of the ridge at the margin in the notch. Seed coat consists of mucilagenous testa and hard brown tegmen. Endosperm fleshy. Embryo *ca* 2.0 mm long with the endosperm below the ridge ; radicle inferior, cylindric, short ; cotyledons compressed, thick, vertical to the plain. [Figs. 6(A-C)]

*Distribution* : Punjab.

*Uses* : Seeds used as laxative. It is demulcent and expectorant. Husk is useful in rheumatism and inflammation. Seeds are said to be mixed with the commercial samples of isubgol.

*Note* : There are only 2 sheets in CAL collected from N.W. India and probably not recorded as being collected in recent years. Since the seeds of this species are reported



A. A seed ; B. T. S. of seed ; C. An embryo ; c. cotyledons ; h. hilum ; m. micropyle ; r. radicle
1. *Plantago asiatica* L. 2. *P. depressa* Willd. 3. *P. himalaica* Pilger 4. *P. amplexicaule* Cav. 5. *P. ciliata* Desf. 6. *P. afra* L. 7. *P. exigua* Murr. 8. *P. lanceolata* L. 9. *P. ovata* Forsk. 10. *Salvia aegyptiaca* L.

to be mixed with commercial samples of *P. ovata,* hence, this species has been included.

7. **Plantago exigua** Murr. Comm. Soc. Reg. Sci. Gotting. 1 : 94, t. 5, 1778-79. *P. pumila* L. f. Suppl. 125. 1781 ; Hook. f. Fl. Brit. India 4 : 708. 1885.

Cells 1-seeded. Seeds 3.5-4.0 × 1.5 mm, blackish brown, linear-oblong, plano-convex, margins raised and recurved, median ridge shallow. Hilum at the middle on the ridge, micropyle at one end of the ridge in the marginal notch. Seed coat consists of thin testa and hard tegmen. Endosperm fleshy. Embryo 2.5-3.0 mm long within the endosperm below the median ridge ; radicle short inferior ; cotyledons longer than the radicle, thick, compressed, vertical to the plain. [Figs. 7(A-C)]

*Distribution* : N. W. India, Rajasthan.

8. **P. lanceolata** L. Sp. Pl. 113. 1753 ; Hook. f. Fl. Brit. India 4 : 706. 1885.

*Local names* : Baltanga (Hindi) ; Bartung (Bombay).

Cells 1-2-seeded. Seeds ± 2.0 × 1.0 mm, black, ovate-oblong, plano-convex, margins recurved, median ridge present. Hilum on the ridge at about the middle ; micropyle at the end of the median ridge at the margin. Seed coat consists of thin mucilagenous testa and hard tegmen. Endosperm fleshy. Embryo *ca* 1.25 mm long, linear with short radicle ; cotyledons compressed, thick vertical to the plain. [Figs. 8(A-C)]

*Distribution* : Western Himalayas from Kashmir to Simla at 1500-2400 m, Maharastra and Tamilnadu.

*Uses* : Commercial samples of isubgol are reported to consist of the seeds of this species. Seeds are considered to be diuratic, purgative and haemostatic.

9. **P. ovata** Forsk. Fl. Aegypt-Arab 31. 1775 ; Hook. f. Fl. Brit. India 4 : 707. 1885.

*Local names* : Isabghul (Pers.) ; Isubgol (Hindi) ; Eshopgol (Beng.) ; Isogola (Mar.) ; Isaphghol, ghoda jeeru (Guj.) ; Isapgola vitulu (Tel.) ; Iskolvirai (Tam.) ; Isafgolu (Kan.) ; Karkatasringi (Mal.).

Cells 1-seeded. Seeds ± 3.0 × 2.0 mm, ovate, golden brown, plano-convex, margins raised and recurved, notched at one end, median ridge present. Hilum at the centre of the median ridge, micropyle at the end of the ridge at the margin. Seed coat consists of very thick mucilagenous testa and hard tegmen. Endosperm fleshy. Embryo *ca* 2.5 mm long within the endosperm ; radicle inferior, flat with a hyaline tip ; cotyledons thick, compressed, vertical to plain. [Figs. 9(A-C)]

*Distribution* : Punjab plains, Maharastra and Rajasthan.

*Uses* : Seeds are demulcent, cooling, diuratic ; used in inflamatory condition of the mucous membrane of the gastro-intestinal and genito-urinary tract, in chronic dysentery, diarrhoea and constipation. This is the true isubgol of commerce.

**Salvia aegyptiaca** L. Sp. Pl. 23. 1753 ; Hook. f. Fl. Brit. India 4 : 656. 1885.

*Local name* : Tukham malanga (Punjab).

Fruits mericarp. Seeds developed from anatropous ovule, ± 2.0 × 1.0 mm, black, ovate-oblong, triquetrus. Hilum on the flat narrower side towards the margin ; micropyle adjacent to the hilum. Seed coat consists of mucilagenous testa and hard tegmen. Endosperm thin, yellowish white. Embryo *ca* 1.5 × 0.7 mm ; radicle short, cylindric, inferior ; cotyledons leafy, cordate with thickened midrib. [Figs. 10(A-C)]

*Distribution* : Delhi to Punjab and Rajasthan, southwards to Gujarat and Maharastra.

*Uses* : Seeds are used as demulcent in diarrhoea and haemorrhoides. It produces copious mucilage and are frequently mixed with seeds of *P. ovata.*

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